SUMMARY

of the doctoral dissertation entitled: "The influence of plasmon resonance in silver nanowires and luminescence of up-converting nanoparticles on the photoswitching process of photochromic molecules"

There are molecules that have the ability to change its state from non-fluorescent to fluorescent form over many cycles. In such a molecule there is an effect called photochromism, which is defined as a light-induced reversible transformation of a chemical compound between two states (ON-OFF) characterized with different absorption spectra. This property has great potential as such molecules can be used for molecular switches or fluorescent probes. To implement such molecules, it is required to develop and understand various possibilities to manipulate the properties via interactions with the surrounding nanostructures.

The aim of this dissertation was to investigate the influence of silver nanowires and up-converting nanoparticles on the photochromic reaction in DTE-py2 molecules. The first nanostructure studied was composed of DTE-py2 molecules and silver nanowires, characterized with lengths of about 10 μm and diameters of about 100 nm. Thanks to that, they exhibit plasmon resonance over almost the whole visible range. The second hybrid nanostructure consisted of DTE-py2 and up-converting nanocrystals $NaYF_4:Er^{3+}/Yb^{3+}$. The nanocrystals were doped with Er^{3+}/Yb^{3+} ions, featuring luminescence at maximum at 550 nm and 650 nm.

In first part through the series of experiments, the effective interaction between DTE-py2 and AgNWs has been established. In the vicinity of AgNWs an increase in fluorescence intensity of DTE-py2 was observed and the photoswitching reaction was considerably faster. Moreover, due to efficient propagation of surface plasmon polaritons in silver nanowires it was possible to demonstrate remote activation of DTE-py2 through the AgNW. In the second set of experiments the interactions between DTE-py2 and $NaYF_4:Er^{3+}/Yb^{3+}$ were examined. It was demonstrated that excitation of nanocrystals with a laser at wavelength 980 nm causes luminescence of $NaYF_4:Er^{3+}/Yb^{3+}$, which can switch the molecules in their vicinity to the ON state. The research also has shown that the presence of DTE-py2 molecules near $NaYF_4:Er^{3+}/Yb^{3+}$ causes a shortening of the decay time, and that the degree of reduction depends on the state of the molecules. In the OFF state of DTE-py2 the decay time is the shortest. Overall, the research carried out in the frame of dissertation has demonstrated substantial influence of the plasmon resonance in silver nanowires and luminescence of up-converting nanoparticles on the optical properties of DTE-py2.